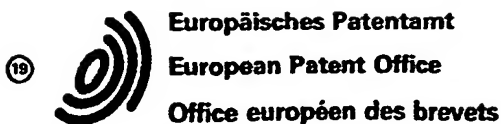


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(11) Publication number:

**0 104 820
A1**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 83305253.3

(51) Int. Cl.²: G 02 B 7/26

(22) Date of filing: 08.09.83

(30) Priority: 10.09.82 US 416639

(43) Date of publication of application:
04.04.84 Bulletin 84/14

(84) Designated Contracting States:
BE CH DE FR GB IT LI LU NL SE

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(54) Optical fiber connector.

(57) A connector for a pair of optical fibers each having a fiber element (14,14') and a protective covering (112) thereover, said pair of optical fibers each having an end portion bare of protective covering and the fiber end faced off to provide for abutting communication characterised by:

a contact (114,114') for each of the glass fibers including, three elongated members each having an elongated cylindrical portion (13,13') and an end portion (120,120') with securing means thereon, said members being so dimensioned as to enable their assembly about the glass fibers with the cylindrical portions contacting the bare glass element periphery and the securing means contacting the fiber protective covering,

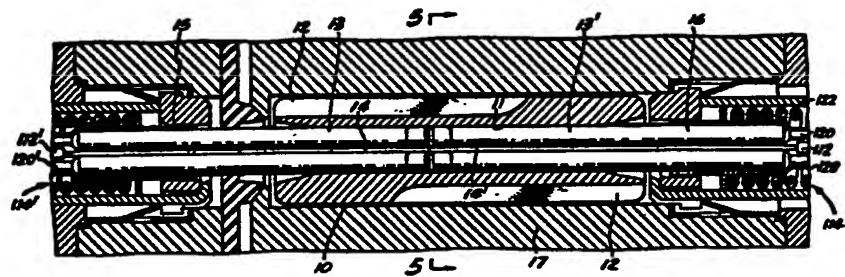
means (122,128) for holding the three elongated members with their cylindrical portions arranged in mutual contacting relation and extending outwardly of the said means; and

an alignment means (10) for receiving the three elongated members assemblies from the pair of contacts and locating the outer ends of the two assemblies with the faced off ends of the fibers at a predetermined spacing,

the alignment means comprising a body of a semi-rigid resilient plastics material, said body including a smooth-sided straight passage therethrough of such cross-sectional dimensions as to enable fitting and sliding receipt of the sets of three pins with included optical fiber therein.

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FIG. 4



OPTICAL FIBER CONNECTOR

The present invention relates broadly to an optical fiber connector and, more particularly, to an improved alignment bushing for use therewith.

5 Optical fibers are relatively small glass or plastic fibers (e.g., several thousandths of an inch in diameter) which are widely used for the transmission of optical signals to a remote location for processing or other utilization. Occasionally, it is necessary
10 either to interconnect two fibers or to repair a fiber which has been broken. Satisfactory interconnection of optical fibers requires that the fiber ends be cut very precisely to a right angle, and the facing ends aligned and brought into very close proximity.

15 Techniques and devices utilised in the past for obtaining such interconnection have been complex, expensive and difficult to use, especially under field conditions and, therefore, have not been found to be completely satisfactory. Certain optical connectors
20 have included high-precision parts and, in some cases, epoxies or other adhesives were required to secure the fibers in place. Moreover, such known connectors necessitated laboratory style approach to assembly which also increased cost of the connectors and limited
25 their use.

Still further, it is desirable that an optical fiber connector protect the fiber from breakage, retain the fiber against so-called "end-slip", as well as have the capability of being reused in the event of fiber damage while in the connector.

An excellent optical fibre connector is that disclosed in EP-A-0076053, published 6th April 1983. The embodiment described includes a fiber contact housing within which three parallel cylindrical pins are brought into peripheral surface contact with each other with a bare fiber end portion being received within the interstice between the pins. Additional means are provided for clamping onto the insulative covering of the fiber immediately adjacent to the stripped bare portion and thereby securing the pins and fiber into a unitary construction. The outermost ends of the three pins and contained fiber of two fibers to be connected extend within the connector for receipt internally of a hollow alignment sleeve where the two bare fibers are brought into alignment and in an abutting relation.

The alignment sleeve described consists of a sheet of spring metal having a plurality of spaced slots formed therein and which sheet has been formed into a hollow tube. Although this spring sleeve has many advantageous aspects it is not completely satisfactory for a number of reasons. First of all, where a spring

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metal sleeve is used, the metal will wear or degrade on repeated mating and unmating which results in undesirable deposit of particulate contamination on the optical fiber surfaces. Secondly, for best results an alignment means should provide resilient circumferential radial loading which is substantially uniform. Present indications are that a metal spring type of alignment sleeve of the type described in this patent can provide uneven or nonuniform exertion of forces onto the fibers and their pin holders. Thirdly, use of a metallic spring alignment means can result in a shift of axial alignment of the pair of coupled fibers due to the perturbing influence of the seams (i.e., spring slots) which may give one or both of fibers a preferential alignment.

Still further, manufacture of a metal spring alignment sleeve within the required tolerances is difficult and relatively costly. Also, assembly of a metallic spring sleeve within a necessary hood or containment housing is a relatively complicated procedure requiring special tools or fixtures.

The aim of the present invention is to improve further upon the proposals already made in EP-A-0076053.

According to the invention there is provided a connector for a pair of optical fibers each having a

glass fiber element and a protective covering there-
over, said pair of optical fibers each having an end
portion bare of protective covering and the fiber end
faced off to provide for abutting communication
5 characterised by:

a contact for each of the glass fibers including,
three elongated members each having an elongated
cylindrical portion and an end portion with securing
means thereon, said members being so dimensioned as to
10 enable their assembly about the glass fibers with the
cylindrical portions contacting the bare glass element
periphery and the securing means contacting the fiber
protective covering,

means for holding the three elongated members with
15 their cylindrical portions arranged in mutual
contacting relation and extending outwardly of the said
means; and

an alignment means for receiving the three elong-
ated members assemblies from the pair of contacts and
20 locating the outer ends of the two assemblies with the
faced off ends of the fibers at a predetermined spac-
ing,

the alignment means comprising a body of a semi-
rigid resilient plastics material, said body including
25 a smooth-sided straight passage therethrough of such
cross-sectional dimensions as to enable fitting and
sliding receipt of the sets of three pins with included

-5-

optical fiber therein.

In accordance with a first embodiment of the described invention, a hollow tubular body or bushing constructed of a material having sufficient rigidity (e.g., thermoplastic polyester) has a bore of circular cross-section sufficient to enable fitting receipt of first and second fibers, each arranged in a three-pin contact, from opposite ends of the tubular body. The outer peripheral surface of the tubular body has a plurality of elongated grooves formed therein extending for a major but not full length of the body with adjacent slots starting from opposite ends of the body. The grooves provide a substantial amount of resiliency transversely of the alignment body bore for embracing the two three-pin contacts exterior and exerting a substantially uniform radial pressure onto each of the contacts irrespective of the orientation of the contacts within the tubular body. Preferably, the tubular alignment body is molded to final form, or, optionally, it may be machined.

In an alternate embodiment of this invention, an elongated generally tubular body having an internal bore of dimensions enabling sliding receipt of a three-pin contact therein has its peripheral surface formed into a plurality of grooves extending completely throughout the body length. Each of the grooves has a

major central portion of substantially uniform depth with both of the groove ends having a bottom wall which slopes upwardly providing an inclined ramp at each end thereof.

5 In the drawings:-

Figure 1 is a perspective view of a first form of an optical fibre contact alignment bushing.

Figure 2 is an end elevational view of the alignment bushing of Figure 1 shown with a three-pin optical
10 fiber contact in place.

Figure 3 is a sectional view taken along the line 3-3 of Figure 2 showing the internal wall thereof laid out in flat form.

Figure 4 is a longitudinal sectional view of the
15 alignment bushing in place in an optical fiber connector as more fully described and illustrated in EP-A-0076053, shown with a pair of fiberoptics contacts aligned therein taken along line 4-4 of Figure 2.

Figure 5 is a cross-sectional view taken along the
20 line 5-5 of Figure 4.

Figure 6 is a perspective view of an alternate embodiment of this invention.

Figure 7 is an end elevational view of the alignment bushing of Figure 6 shown with a three-pin optical
25 fiber contact included.

Figure 8 is a longitudinal sectional view showing

the alignment bushing of Figure 6 in use taken along line 8-8 of Figure 7.

Figure 9 is a cross-sectional view taken along the line 9-9 of Figure 8.

5 Turning first to Figure 4 of the drawings, there is shown the relevant part of a connector as further described and illustrated in EP-A-0076053. The connector comprises contacts 114,114' for the respective glass fibers which each have a fiber or core 10 14,14' and a protective covering 112 thereover. The contact includes three elongated members each having an elongated cylindrical portion respectively 13,13' and an end portion respectively 120,120'. Although not shown in Figure 4 the end portions 120,120' each have 15 an enlargement with raised circular ridges for making contact with the fiber protective covering 112. As shown also in Figure 2 the elongated members form an assembly about the glass fiber with the cylindrical portions 13,13' contacting the bare glass element 20 periphery and the securing means contacting the fiber protective covering. The contact housing 122 and an elongated hollow ferrule 128 constitute means for holding the three elongated members with their cylindrical portions arranged in mutual contacting relation 25 and extending outwardly thereof. An alignment bushing 10 receives the three elongated members from the pair

of contacts and locates the outer ends with the faced off ends of the fibers at a predetermined spacing.

In the present invention the alignment bushing 10 comprises a body of semi-rigid resilient plastics material, the body including a smooth-sided straight passage or bore 11 therethrough of such cross-sectional dimensions as to enable fitting and sliding receipt of the sets of three pins with included optical fiber therein.

The bushing may broadly be constituted by a plane hollow cylinder of appropriate material. However it is advantageous to form the bushing with generally uniformly circumferentially distributed parallel grooves e.g. as shown in Figures 1 or 6. This allows greater latitude in the outside diameter of the bushing and in particular it allows a relatively thick walled bushing to be utilized while still retaining a resilient compression fit which is circumferentially uniform. This means that the dimensions of the remainder of the connector do not require to be determined by the dimensions of the bushing with particular regard to the resiliency of the material available.

A plurality of longitudinally extending grooves 12 are formed in the peripheral surface of the bushing 10, the grooves being angularly spaced with respect to each other about the bushing circumference. More

particularly, each of the grooves 12 extends from one end of the bushing to a point past the centerline of the bushing long dimension. Immediately adjacent grooves 12 start from the opposite end thereby providing an overlapping relationship of the inner ends of the grooves in the bushing central region. That is, in the bushing portions immediately adjacent each end the body wall is elastically relieved by three longitudinal grooves as shown in Figure 1, whereas in the central region of the body wall there are six grooves. By this construction, the flexibility of the bushing wall is greatest in the central region and least at the outer ends which has advantageous results that will be described herein.

Although other materials may be found satisfactory for this purpose, the best materials found to date for use in constructing a bushing 10 are polyphenyl sulfide sold under the Trade Mark Ryton (Phillips Petroleum) and thermoplastic polyester, sold under the Trade Mark Valox (General Electric). Also, most uniform results have been obtained by machining the grooves 12, although it is contemplated that the bushing 10 may be satisfactorily manufactured by molding to final form.

As has already been described, an optical fiber

contact with which the bushing 10 is especially advantageous, has three (3) cylindrical pins 13 that include a bare optical fiber 14 held in the interstice between their peripheral surfaces (Figures 2 and 5). The diameter of the bushing bore 11 is such that the pins and included fiber can be fittingly received therewithin and the bushing will exert a highly uniform radial force onto the pins and fiber. Since the bore walls are smooth and uniform, there is no variation in fiber alignment resulting from inserting the pins and fiber at different angular orientations.

Turning to Figure 4, first and second pin contacts 15 and 16 of the kind set forth in the referenced co-pending patent application have corresponding sets of three pins 13, 13' including fibers 14 and 14', respectively. The three-pin holders and fibers are located within the alignment bushing 10 with the fiber facing portions being very slightly spaced apart and precisely aligned with the longitudinal axis of bore 11. A protective housing 17 is shown enclosing the bushing 10.

For the ensuing description of an alternative embodiment, reference is made simultaneously to Figures 6-9. The alignment bushing 18 is an elongated tubular body having a uniform circular bore 19. A plurality of longitudinally grooves 20 which have a uniform depth

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throughout the major central portion of the bushing and an upwardly sloping floor or bottom closely adjacent each end of the bushing. In this way the central bushing walls are more resilient than the end portions.

5 Installation of the three-pin fiber contacts is the same as described in regard to the first embodiment. Still further, as shown in Figure 8, the overall relation of a pair of fiber contacts to "interconnect" two fibers is highly similar to that of the first

10 embodiment.

In using either version of the alignment bushing, it may be desirable to enclose it within a protective housing or hood 17 as shown in Figures 4 and 8. Such a housing may be constructed of rubber or synthetic

15 plastic, for example, and serving to protect the bushing and included three-pin contact from possible physical damage and the ingress of moisture, dust and dirt.

The described bushing provides a means for locating a pair of three-pin contacts with included fibers in a precisely aligned relation. Such optical signals may be transmitted from one fiber to the other with a minimum of loss or signal diminution. The aligned relationship can be achieved by merely inserting the

20 three-pin contacts into the bushing bore irrespective of the angular relationship of contacts and bushing.

25

Since the bushing construction provides a highly uniform radial force onto the contacts throughout the full circumference of the bore wall this prevents misalignment that could result from uneven pressure on the
5 contacts. Although the radial pressure at the outer end portions is greater than at the center of the bushing, there is a relatively large central area in both embodiments where the radially exerted force is highly constant.

CLAIMS:

1. A connector for a pair of optical fibers each having a glass fiber element (14,14') and a protective covering (112) thereover, said pair of optical fibers
5 each having an end portion bare of protective covering and the fiber end faced off to provide for abutting communication characterised by:

a contact (114,114') for each of the glass fibers including,

10 three elongated members each having an elongated cylindrical portion (13,13') and an end portion (120,120') with securing means thereon, said members being so dimensioned as to enable their assembly about the glass fibers with the cylindrical portions con-
15 tacting the bare glass element periphery and the securing means contacting the fiber protective covering,

means (122,128) for holding the three elongated members with their cylindrical portions arranged in
20 mutual contacting relation and extending outwardly of the said means; and

an alignment means (10) for receiving the three elongated members assemblies from the pair of contacts and locating the outer ends of the two assemblies with
25 the faced off ends of the fibers at a predetermined spacing,

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the alignment means comprising a body of a semi-rigid resilient plastics material, said body including a smooth-sided straight passage therethrough of such cross-sectional dimensions as to enable fitting and
5 sliding receipt of the sets of three pins with included optical fiber therein.

2. A connector according to claim 1 wherein said body has portions (12,20) removed from the peripheral
10 surface providing resilient flexible wall surfaces thereunder, the removed portions being uniformly distributed around the passage in any cross-section.

3. A connector according to claim 2, in which the
15 removed portions are grooves (12,20) arranged generally parallel to each other and uniformly spaced about the body.

4. A connector according to claim 3, in which
20 immediately adjacent grooves (12) begin at different ends of the body and extend only partway between the ends:

5. A connector according to claim 3, in which the
25 grooves (20) extend from one end of the body to the other, with upwardly sloping bottom walls closely adjacent to each end.

6. A connector according to claim 2 or claim 3,
in which the body passage is uniformly circular in
cross-section and of such dimensions that body walls
under the removed portions (12,20) are distended when
5 three pins and included fiber are received in the body
passage.

7. A connector according to claim 6, in which the
passage distension occurs only in the regions where
10 body portions are removed.

FIG. 1.

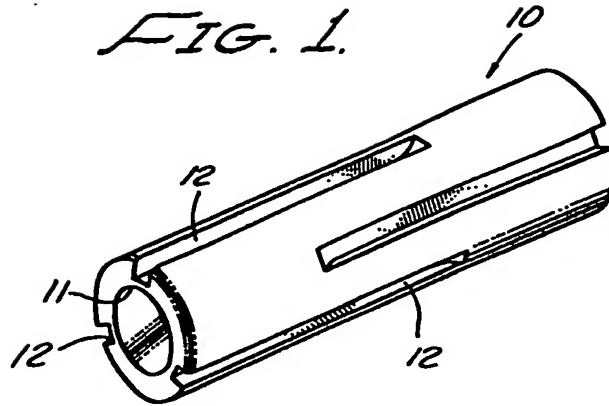


FIG. 2.

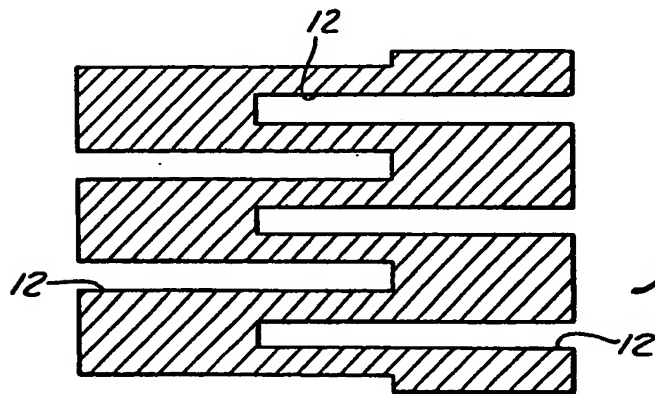
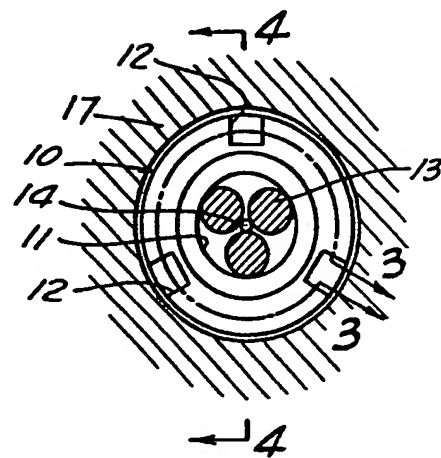


FIG. 3.

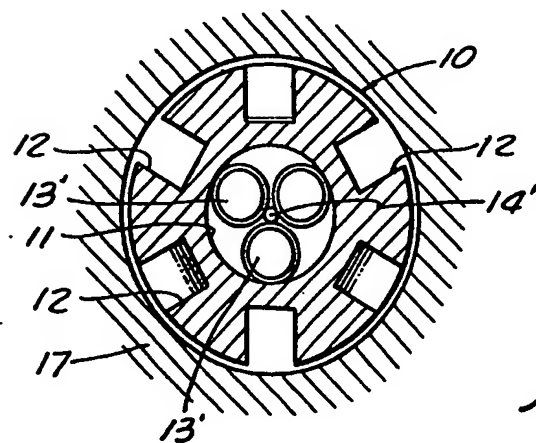


FIG. 5.

FIG. 4.

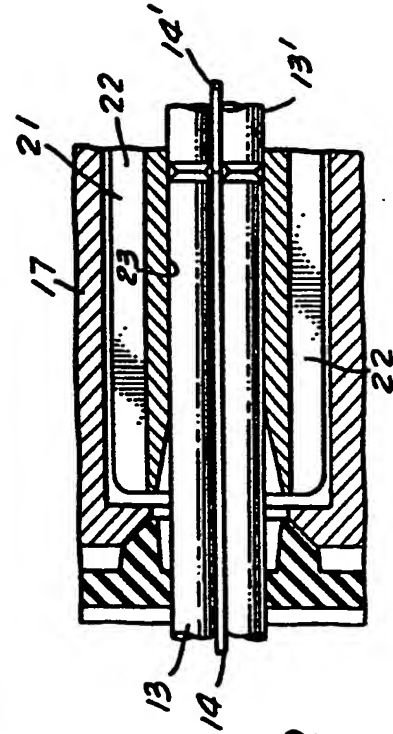
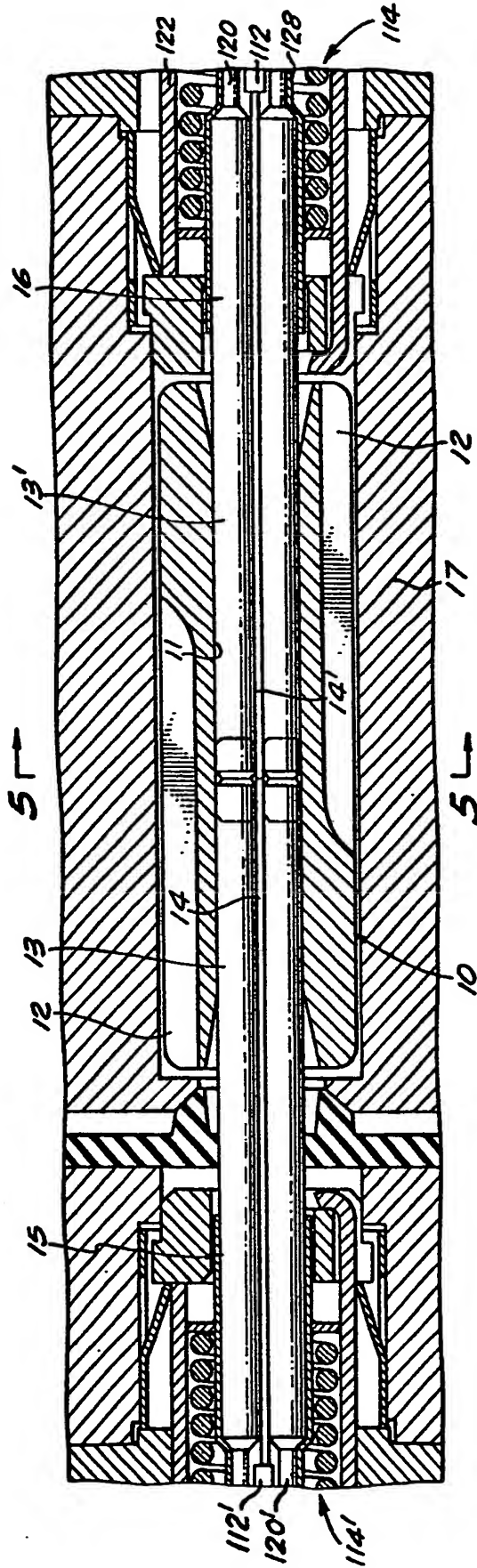
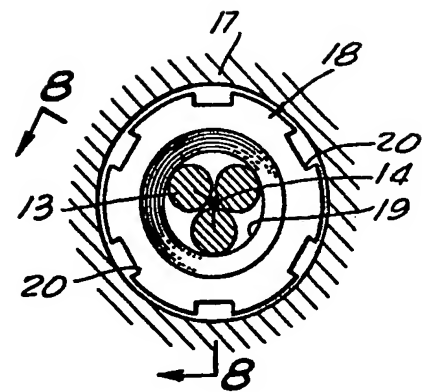
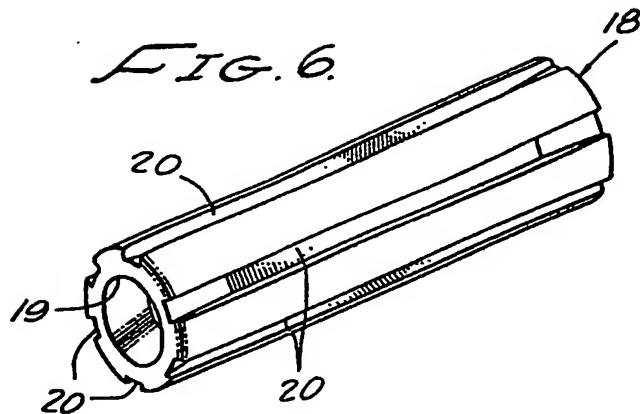
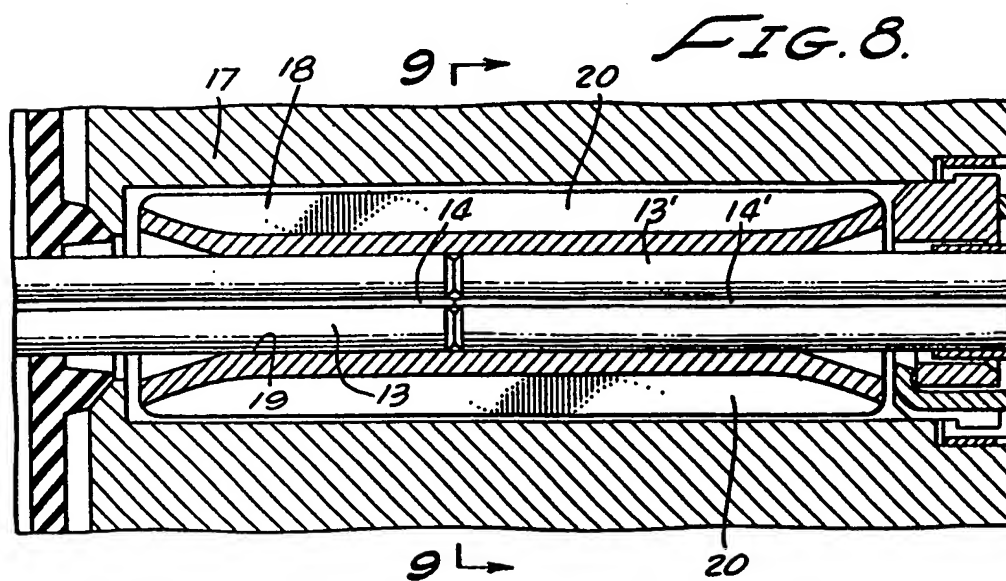
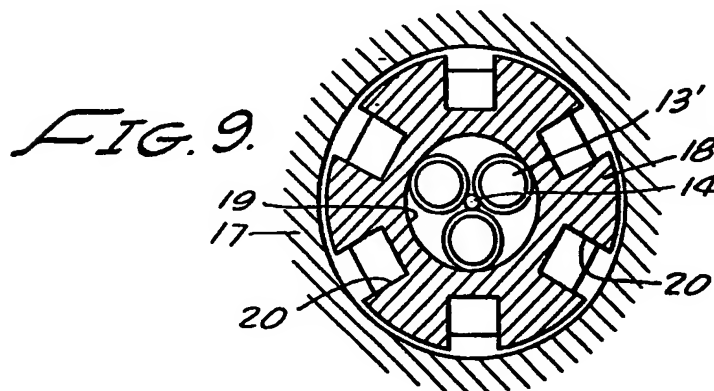


FIG. 10.

*FIG. 7.*



European Patent
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EUROPEAN SEARCH REPORT

0104820

Application number

EP 83 30 5253

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
Y	DE-A-2 844 744 (THOMSON CSF) * Claim 1, figures *	1	G 02 B 7/26
Y	US-A-4 099 832 (A.W. WARNER) * Claim 4, figure 2 *	1	
A	DE-A-2 826 717 (FELTEN & GUILLEAUME CALRSWERK AG) * Claim 1 *	1	
A	DE-B-2 723 440 (SIEMENS AG) * Claims 6, 7; figure 3 *	2-4	
A	GB-A-2 005 863 (BUNKER RAMO CORP.) * Page 3, lines 65-72, 104-100 *		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
			G 02 B 7/26
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 05-12-1983	Examiner FUCHS R
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